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SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

SUBSCRIPTIONS.—United States and Canada..... .....$3.50 a year.
Great Britain and Europe..... 4.50 a year.

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SKETCH OF THE FLORA OF DEATH VALLEY, CALIFORNIA.[1]

BY FREDERICK VERNON COVILLE, WASHINGTON, D.C.

SINCE Death Valley, as shown by the published records of the Weather Bureau,[2] is the hottest and dryest area known in the United States, and probably in the world, and since the observations of the Death Valley Expedition showed that these extreme climatic conditions are reflected in its vegetable life, a description of this flora has an interest even greater than that incited by the average desert vegetation.

One not familiar with the Mohave and Colorado deserts must imagine broad stretches of treeless plains, out of which rise abrupt mountains, not covered with trees but exhibiting naked faces of rugged rocks with no covering of soil or lichens to conceal even their coloration. In the northern portion of the Mohave Desert region, in which Death Valley lies, the mountain ranges are closer together and the plain is cut up into narrow deep valleys trending in a general north and south direction. The deepest of these is Death Valley, its length about 175 miles, and its greatest breadth from peak to peak about 20 miles. The lowest portion of the valley is a moist plain about 40 miles long by 2 to 6 miles broad, gleaming with salt and alkali. Between this and the mountain faces are sloping gravelly mesas, at some parts of the valley 6 miles broad, at other points entirely absent. The mountains themselves are abrupt and naked, the Funeral Mountains on the east rising 7,000 feet, the Panamints on the west almost 11,000. Upon the crest of the Panamint range is an evergreen forest of pines and junipers.

The salt-flat in the bottom of the valley is quite devoid of vegetation, not because the moisture in the soil is too scant, but because it is so saturated with salt and alkaline compounds that no plant can live upon it.

The mesa bears a growth of scattered shrubs not sufficient, even at a distance, to conceal the ground between them. No larger plant is to be seen except at certain points where, along the line between the mesa and the salt-flat, the sub-soil is sufficiently moist to support the mesquite. This is a low, almost shrub-like, tree which commonly attains a height of 10 to 15 feet. This characteristic then, the absence of trees, may be taken as the most conspicuous feature of the Death Valley vegetation, as it is of the desert in general.

[1] In January, 1891, an expedition was sent out by the U. S. Department of Agriculture to explore the region of Death Valley, California, and to make a biological survey of it. About nine months were spent in the field, and the report, now nearly completed, will soon be published by the department. The general botanical features of the region, a full discussion of which will constitute a part of the final report, are here described by the botanist of the expedition.

[2] U. S. Department of Agriculture, Weather Bureau Bulletin No. 1, Notes on the Climate and Meteorology of Death Valley, California, by Mark W. Harrington. Washington, 1892.

The mesas bear, besides the shrubs, a large number of herbaceous plants which, although in late summer and in winter dead and barely noticeable, in the spring months of a rainy year come to be in some places really conspicuous. One of the desert sunflowers (*Encelia eriocephala*) was at one point so abundant that it even made the mesa appear yellow, at a distance, over an area many rods in extent. The general impression, however, of the traveller who is not a botanist is that the vegetation of the valley consists of clumps of mesquite set here and there along the edge of the salt flat, and a few scattered greasewood and creosote bushes on the mesa.

Not all parts of the mesa are, however, supplied with even so much plant life. At the mouth of Furnace Creek Cañon is a broad slope composed of mixed gravel, sand, and clay, a matrix capable, in some parts of the desert, of supporting a varied flora; but here for hundreds of yards is seen no plant whatever except one of the smallest greasewoods (*Atriplex hymenelytra*), its individuals growing far apart and attaining the height of barely a foot.

In still other portions of the mesa occurred a phenomenon which, if it is here interpreted rightly, is the best index that we have of the intense heat of this region. The higher portions of the mesa are cut up by the dry channels of the streams that follow mountain cloudbursts. Between these channels, which are called sometimes arroyas but oftener washes, are broad blocks of the mesa, whose surface has lain undisturbed for undoubtedly many thousands of years. The surface of the soil is covered closely with a layer of small, flat, water-worn stones which have accumulated on the top of the ground by the gradual washing out of their original clayey matrix. The erosion of the soil has undoubtedly been brought about by the slow agency of direct rainfall. The upper surfaces of the stones have a dark brown, almost black, color, and the dull lustre of a hard-burned brick. The coloration of these stones is ascribed to binoxide of manganese, produced by oxidation due to intense light acting during long periods of time[3]. These so-called sunburned areas in Death Valley bear no vegetation whatever. Even the two desert annuals, *Chorizanthe rigida* and *Chænactis attenuata*, which grow at other points in the hottest spots, are here wanting. The soil, a firm clayey one, is good, and the surface receives just as much rainfall as other parts of the valley. The phenomenon is explained by no hypothesis except that of intense heat, and a consideration of the evidence, in the absence of direct experiment, indicates that such a cause may be quite sufficient.

Experiments by Sachs upon active protoplasm have shown that when subjected to a temperature of 50° C. (122° F.) it ceases to carry on its functions, disintegration sets in, and death follows. But a plant may be situated in an atmosphere whose temperature is higher than this without itself attaining so great a heat; for two causes tend to reduce its temperature, the non-conductive nature of the tissues themselves, and the evaporation that characterizes transpiration. Yet even these sources of protection may be overridden by a still higher temperature. The well-known retention of vitality in the case of the spores of certain fungi after exposure to a temperature of even 212° F. does not indicate that a desert plant can endure a similar degree, for the protoplasm of the fungus spore is not in a state of activity, but that of a germinating or growing plant is.

The Weather Bureau tables, in the bulletin cited above, show five records of a temperature of 122° F. This is the temperature of air sheltered from the effects of radiation. The temperature of air exposed to ordinary conditions of radiation must be somewhat higher than this, and the temperature of gravel pebbles on the surface of the ground still higher; but, according to the principles of molecular physics, the black stones that have been described should reach a degree of heat decidedly greater than either of the other bodies. It is confidently believed that a temperature of from 140° to 150° F. is frequently attained under these conditions, and in such a temperature a growing plant would undoubtedly perish from heat.

That the flora of the valley may be more readily considered, all the species observed there have been arranged in groups. A review of these groups suggests some of the leading characteristics

[3] See Annual Report of the Wheeler Survey for 1876, pp. 178, 179.